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REPORT NO. 84-2-19 3430
ALEXANDRIA FIELD OFFICE MAY 1984

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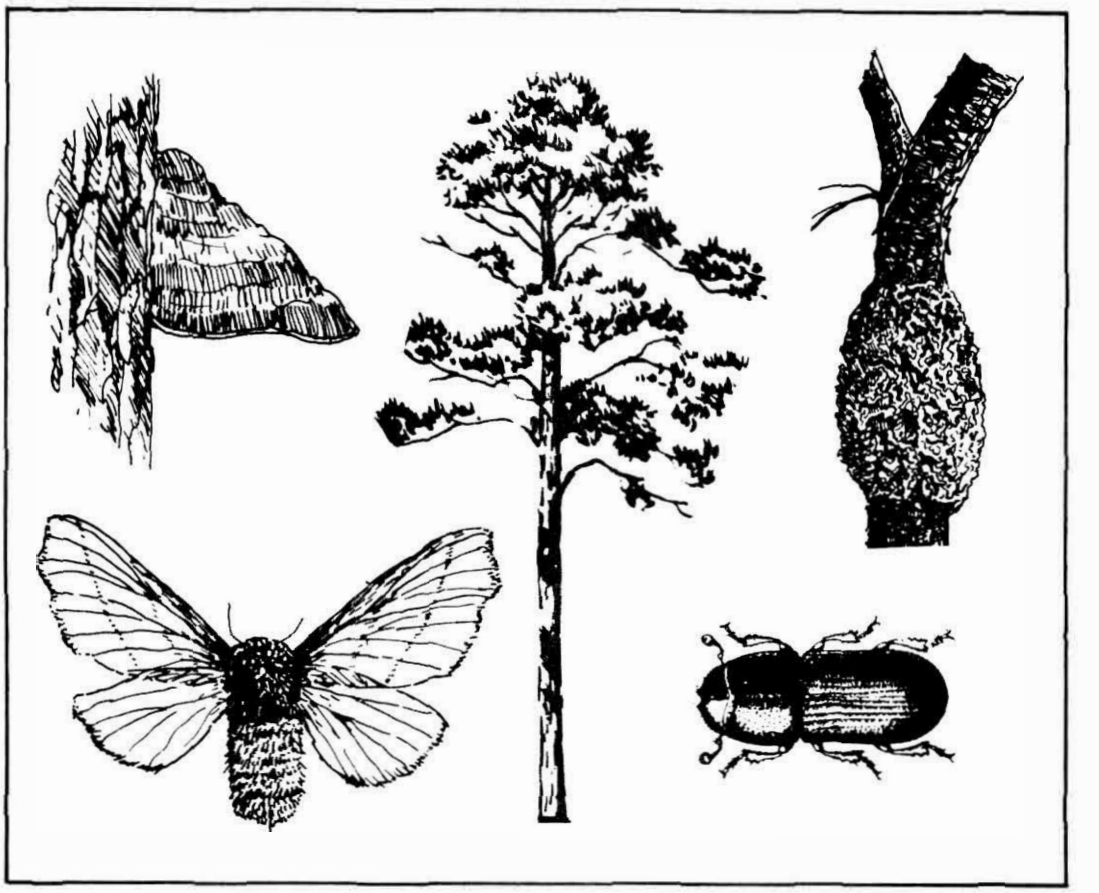

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EVALUATION OF PITCH CANKER AND FUSIFORM RUST IN THE ERAMBERT SEED ORCHARD BROOKLYN, MISSISSIPPI 1983

Dale A. Starkey[1/] and Charles E. Affeltranger[1/]

Abstract

A systematic row survey of selected seed sources revealed a low level (5.5% incidence) of pitch canker and 1% incidence of fusiform stem rust. Incidence of pitch canker varied by seed source from a low of 1% in south Mississippi loblolly to a high of 13.8% in Alabama slash. Clonal differences in incidence were found. Incidence of stem rust varied from 2.4% (Alabama loblolly) to 22.3% (Florida slash). Average number of cankers per tree was approximately 1 and average percent girdle ranged from 37% to 58%. Incidence of branch rust ranged from 0 to 8.8% and averaged about 1 branch rust gall per tree.

INTRODUCTION

Pitch canker of southern pines, caused by the fungus Fusarium moniliforme Sheld var. subglutinans Wr. and Reink. is an intermittently damaging disease of forest stands (Blakeslee and Oak 1979, Phelps and Chellman 1976), seed orchards (Dwinell and others 1977, Phelps and Chellman 1976) and forest nurseries (Barnard and Blakeslee 1980). Potential to damage flowers, cones, and seed has been demonstrated for slash and loblolly pines (Miller and Bramlett 1979).

Many species of southern pine are susceptible to pitch canker infection. Slash, shortleaf and Virginia pine are highly susceptible. Loblolly is less susceptible (Dwinell 1978). Most research work has been performed on slash and loblolly pine in plantations and seed orchards.

Effects of pitch canker outbreaks in southern pine seed orchards are not yet fully understood. In addition to shoot damage, reduced cone/seed production has been reported by some (Dwinell and others 1977), while bumper cone crops have occurred during a pitch canker outbreak (Kuhlman and others 1982).

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Clonal variation in susceptibility is known to exist in loblolly pine (Kuhlman and others 1982; Kelly and Williams 1982) and slash pine (Phelps and Chellman 1976).

The most serious effect of a pitch canker outbreak in a seed orchard may not be shoot mortality but the reduction in cone and seed yield and the reduction in seed quality in highly susceptible clones.

Fusiform rust caused by the fungus Cronartium quercuum (Berk.) Miy. ex Shirai f. sp. fusiforme is the most serious disease of southern pines. In seed orchards the disease causes the loss of ramets due to stem breakage at ~~cankers and~~ the loss of ramet utility due to branch and stem deformations. The inherent resistance or susceptibility of orchard trees is of course passed on to progeny through seed production.

The objectives of this evaluation were to determine the incidence and severity of pitch canker and fusiform rust in the Erambert Seed Orchard and document any differences among species, seed sources and clones.

MATERIALS AND METHODS

A systematic row survey of each seed source at the Erambert Seed Orchard, Brooklyn, MS was made according to the size of each as follows:

Seed Source	Rows Surveyed	%
Alabama Loblolly	Every 5th	20
South Mississippi Loblolly	Every 5th	20
Mississippi Shortleaf	Every other	50
High Gum Yield Slash	Every other	50
Florida Slash	Every 5th	20
Alabama Slash	Every other	50
Mississippi Slash	Every 5th	20

No longleaf seed sources were surveyed.

Each ramet in surveyed rows was observed from all four sides by two observers and rated jointly for the following:

Pitch Canker

Rating K

1 = None
2 = 1 - 3 lateral branches
3 = terminal
4 = terminal and 1 - 3 lateral branches
5 = 5 - 10 branches
6 = > 10 branches < 50% of crown
7 = > 50% of crown
8 = dead due to PC

Rating F

1 = None
2 = 1-10% diseased
3 = 11 - 20%
4 = 21 - 30%
5 = 31 - 40%
6 = 41 - 50%
7 = > 50%
8 = dead

Fusiform Rust

Number stem cankers
Position of each canker: 1 = lower 1/3 bole
2 = med 1/3 bole
3 = upper 1/3 bole
Percent girdle of each canker
Number branch galls (within 15" of stem)

Miscellaneous

Dioryctria sp. (coneworms) were recorded.

Rating K is a modification of the system of Kuhlman and others (1982). The others were devised for this survey by us.

RESULTS

Pitch Canker

Overall incidence of pitch canker in the Erambert Seed Orchard is currently low; 5.5% of all ramets are affected (table 1). Incidence by seed source was variable and ranged from a low of 1% in south Mississippi loblolly to a high of 13.8% in Alabama slash. Little difference in overall disease incidence occurred between the three pine species.

The Alabama loblolly seed source had the greatest proportion of clones affected at 36%. Lowest was south Mississippi loblolly with only 2%.

Severity ratings (K) ranged from means of 2.4 for Mississippi shortleaf to 4.2 for Florida slash. Rating F averages were less divergent but similar to K ratings. Severity rating averages were greatest in slash pine and least in shortleaf. While mean severity ratings were generally low, nonetheless some individual ramets were seriously affected.

Table 2 lists the most heavily diseased clones by seed source. Susceptibility groupings have been assigned by examining a Duncan's multiple range analysis of disease incidence by clone for 3 orchards, and utilizing natural "groups" occurring at the P = .01 level. Average severity ratings by clone are not presented as they too often contained a very small number of trees.

Fusiform Rust

Incidence of fusiform stem cankers in the orchard was 11%. Slash pine seed sources had the greatest incidence (16.5%) while no cankers were found in shortleaf pine. The Florida slash seed source had the highest incidence of stem cankers(22.3%); Alabama loblolly had the lowest (2.4%). The greatest proportion of diseased clones occurred in Florida slash (88%) with the lowest occurring in high gum yield slash (24%) (Table 1).

Table 1. Incidence (percent of trees infested) and severity of pitch canker, and fusiform rust by seed source and species in the Erambert Seed Orchard, 1983.

Seed Source or Species	Pitch Canker				Fusiform Rust					
					Stem Cankers				Branch Cankers	
	Trees Infested	% Clones Diseased	$\bar{x}$ Rating K	$\bar{x}$ Rating F	Trees Infested	% Clones Diseased	$\bar{x}$ No. Cankers	Ave. % Girdle	Incidence	$\bar{x}$ No. Galls
Mississippi shortleaf	5.5	10.0	2.4	2.0	0.0	0.0	0.0	0.0	0.0	0.0
So. Mississippi loblolly	1.0	2.0	3.5	2.0	11.2	40.0	1.0	37.0	1.0	1.0
Alabama loblolly	7.9	36.0	3.6	2.5	2.4	36.0	1.3	57.9	0.9	1.4
Mississippi slash	7.8	26.0	3.6	2.1	10.4	36.0	1.1	43.5	0.0	0.0
Alabama slash	13.8	20.0	3.9	2.8	18.1	36.0	1.1	51.4	5.2	1.0
Florida slash	3.6	16.0	4.2	3.6	22.3	88.0	1.1	47.0	8.8	1.4
High Gum Yield Slash	1.2	3.0	3.0	2.0	10.8	24.0	1.1	49.1	7.2	1.0
Shortleaf	5.5	-	2.4	2.0	0	-	0	0	0	0
Loblolly	6.1	-	3.6	2.5	4.7	-	1.1	44.9	0.9	1.3
Slash	5.1	-	3.8	2.8	16.5	-	1.1	47.4	6.1	1.2
Total	5.5	-	3.6	2.6	11.0	-	1.1	46.9	3.7	1.2

Table 2. Incidence (percent of trees infested) of pitch canker by clone within seed source in the Erambert Seed Orchard, 1983.

	Alabama Slash		Mississippi Slash		Florida Slash		High Gum Yield Slash	
	Clone	Incidence	Clone	Incidence	Clone	Incidence	Clone	Incidence
High	14*	100	37	71	13	86		
	18	100						
	39	100						
Medium	21	50	45*	50	33	36	63*	50
	40	50	8	33			72	25
	9	33	19	33				
	28	33	7	25				
	32	33						
	11	25						
	37	20						
Low			30	20			21	20
			36	20				
			42	20				
			4	17	8	17		
			44	17	5	14		
			12	14	47	8		
			10	13	19	8		
			46	11	49	8		
					35	7		

	Alabama Loblolly		South Mississippi Loblolly		Mississippi Shortleaf	
	Clone	Incidence	Clone	Incidence	Clone	Incidence
High	12	90	48	67	17*	100
Medium	30	60			7	33
	41	56			18	33
	14	27			1	25
	7	22			6	25
Low	31	20				
	45	19				
	25	18				
	46	17				
	40	15				
	21	10				
	2	8				
	15	8				
	34	8				
	32	6				
	47	6				
	20	6				

*limited observations

All affected seed sources averaged very close to one stem canker per tree. Average per cent girdle ranged from a high of 58% in Alabama loblolly to 37% in south Mississippi loblolly.

Branch galls occurred most frequently in Florida slash and high gum yield slash while none were found in Mississippi loblolly. All sources with branch galls averaged very close to 1 gall per tree.

Most severely affected clones are listed in Table 3.

Dioryctria sp. attack ranged from 2-3% in all species and sources except for Mississippi shortleaf where it averaged 18.7%.

DISCUSSION

Since incidence and damage due to pitch canker are currently rather low, the most severely damaged ramets may be rogued or pruned to manage the disease (Blakeslee et al. 1980). This should reduce the inoculum levels of the fungus in the orchard and aid in limiting further infections. Also, with the low levels of disease present, the relative susceptibility or resistance of clones (Table 2) may not have been fully expressed. Had the orchard been more heavily diseased, some clones with apparent resistance might have sustained more infection while others might have remained unaffected, more accurately expressing resistance. It is likely, however, that clones heavily diseased now (while overall disease levels are low) are indeed highly susceptible. Some clones (noted in table) were represented in the survey by only a very limited number of ramets and clonal rankings should therefore be viewed as only generally indicative of susceptibility.

Incidence of stem rust was also rather low but in Florida slash and Alabama slash higher infection levels indicate generally greater susceptibility. The proportion of clones affected was much greater in Florida slash at 88% than any other source. Average percent girdle varied little between seed sources. Branch gall incidence is currently low enough to be of little concern, although many of the stem cankers were probably initiated from branch galls. Most of the stem cankers will probably continue to enlarge and these trees will be more likely to die or be weakened at that point on the stem so that wind breakage occurs. Also, stem cankers are attractive places for attack by Dioryctria sp. Future losses of ramets can be expected where large stem cankers are present.

The lists of stem rust incidence by clone are general indicators of the susceptibility of clones to fusiform rust and may be useful in controlled pollination studies. It must be remembered, however, that in any given year, infections may be highly variable on the same genetic material due to variation in weather and site factors. The Erambert Seed Orchard is in a moderate (30-50%) rust hazard zone for both loblolly and slash pines.

Table 3. Incidence (percent of trees infested) of fusiform rust (stem cankers) by clone within seed source in the Erambert Seed Orchard, 1983.

Florida Slash		Alabama Slash		High Gum Yield Slash		Mississippi Slash		South Mississippi Loblolly		Alabama Loblolly	
Clone	Incidence	Clone	Incidence	Clone	Incidence	Clone	Incidence	Clone	Incidence	Clone	Incidence
33	64	15*	100	37*	100	13	50	46	100	13	50
45	63	41	67	44*	100	26	50	5	50	26	50
46	55	11	50	34	67	30	40	36	50	30	40
48	55	14	50	17	50	10	38	6	33	10	38
21	50	40	50	29	50	21	33	21	33	21	33
29	50	45	50	65	50	34	33	37	33	34	33
30	50	47	50	75	50	14	29	42	33	14	29
41	44	4	40	91	50	22	25	48	33	22	25
35	40	6	33	36	33	33	25	8	25	33	25
17	38	9	33	40	33	43	25	16	25	43	25
36	38	16	33	78	33	17	20	17	25	17	20
50	33	18	33	84	33	18	17	19	25	18	17
19	31	28	33	13	25	19	17	34	25	19	17
49	31	32	33	32	25	24	17	35	25	24	17
6	29	36	33	57	25	12	14	44	25	12	14
13	29	42	33	61	25	37	14	10	20	37	14
43	25	24	25	64	25	6	13	22	20	6	13
47	25	25	25	87	25	49	11	31	20	49	11
16	23			90	25			38	20		
9	22			94	25			28	17		
20	22			21	20						
2	20			45	20						
10	20			59	20						
42	20			80	20						
12	17										
27	17										
34	17										
37	17										
4	15										
14	15										
1	14										
5	14										
22	14										
24	14										
25	14										
7	13										
18	13										
44	11										
11	9										
23	9										
28	9										
31	9										
32	9										
38	9										

* limited observations

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